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SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION

# Demonstration Bulletin

## *Disc Tube™ Module Technology*
### *Rochem Separation Systems, Inc.*

**Technology Description:** Rochem Separation Systems, Inc. has developed the Disc Tube Module (DTM) technology, an innovative membrane separation process for removal of contaminants from liquid hazardous waste streams. Traditionally, membrane separation processes have been used as a secondary or polishing step in waste treatment schemes. However, Rochem's DTM technology uses an innovative process configuration which allows it to be the primary treatment for waste streams such as landfill leachate. The DTM technology is designed to treat waste that is higher in dissolved solids content, turbidity, and contaminant levels than waste treated by conventional membrane separation processes.

The patented membrane module features larger feed flow channels and a higher feed flow velocity than other membrane separation systems. According to the technology developer, these characteristics allow the DTM greater tolerance for dissolved solids and turbidity and a greater resistance to fouling and scaling of the membranes. Suspended particulates are readily flushed away from the membrane during operation. The high flow velocity, short feed water path across each membrane, and the circuitous flow path create turbulent mixing to reduce boundary layer effects and minimize membrane fouling and scaling. According to the developer, the DTM design allows easy cleaning and maintenance of the membranes. Figure 1 details a cutaway diagram of the Disc Tube Module. Membrane material for the DTM is formed into a cushion with a porous spacer material on the inside. The membrane cushions are alternately stacked with hydraulic discs on a tension rod. The hydraulic discs support the membranes and provide flow channels to pass the feed liquid over the membranes. After passing through the membrane material, permeate flows through permeate collection channels to a product recovery tank. A stack of cushions and discs is housed in a pressure vessel. Flanges seal the ends of the module in the pressure vessel and provide the feed water input and the product and reject output connections. The number of discs per module, number of modules, and the membrane materials can be custom-designed to suit the application. Modules are typically combined in a treatment unit or stage. The DTM technology can use reverse osmosis, ultrafiltration, or microfiltration membrane materials. These membranes are more permeable to water than to contaminants or impurities. Water in the feed is forced through these membranes by pressure and becomes permeate consisting of a larger fraction of water with a lower concentration of contaminants. The impurities are selectively rejected by the membranes and are thus concentrated in the smaller fraction of the concentrate left behind. The percentage of water that passes through the membranes is a function of the operating pressure, membrane type, and concentration of the contaminants.

**Waste Applicability:** According to the technology developer, the DTM technology can treat liquid waste streams containing hazardous wastes, volatile and semivolatile organic compounds, metals, and radioactive wastes. The technology has been used to treat landfill leachate, oil/water mixtures, and solvent/water mixtures.

**Demonstration Approach:** The U.S. EPA Superfund Innovative Technology Evaluation (SITE) Program conducted a Demonstration Test at the Central Landfill in Johnston, Rhode Island where approximately 33,000 gallons of hazardous landfill leachate were treated by the DTM technology using reverse osmosis membranes. The leachate contained chlorobenzene and 1,2-dichlorobenzene at average concentrations of 21 mg/L and 16

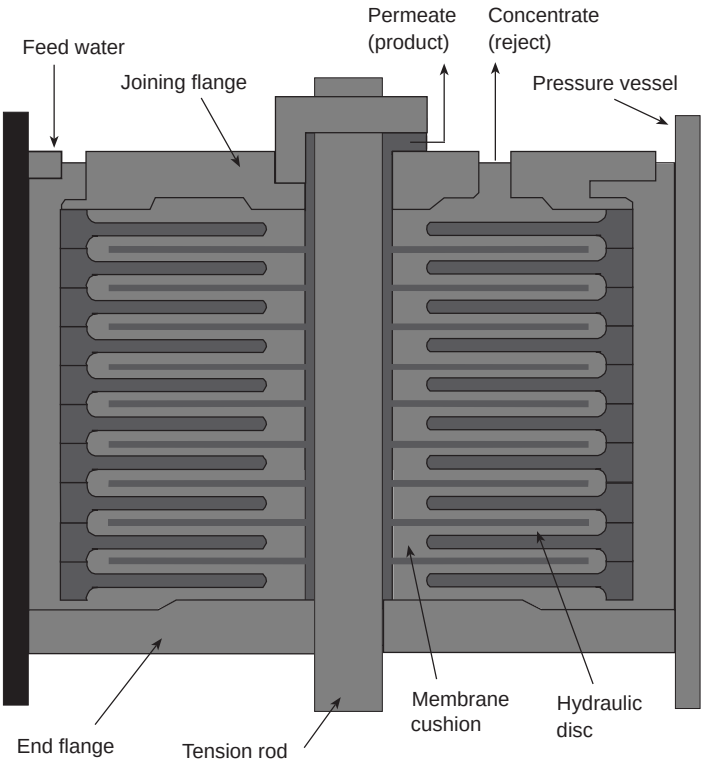


**Figure 1.** Cutaway Diagram of the Disc Tube Module.

mg/L, respectively, and lower levels of toluene, xylenes, and ethylbenzene; total organic carbon at an average concentration of 460 mg/L; low mg/L levels of heavy metals; and total dissolved solids at an average concentration of 4,900 mg/L. For treatment of this waste, a three-stage DTM process was utilized. Two stages were used in series to treat the landfill leachate and produce the final permeate. The third stage was a high pressure unit (HPU) which further treated the concentrate rejected by the first stage to increase the system water recovery. Media and cartridge filters were built into each unit to remove suspended particulates, and acid was added at the first stage and at the HPU for pH control.

The critical objectives of the Demonstration Test were to determine whether the technology was capable of meeting criteria for (1) percent rejection of the contaminants, (2) treated water recovery rate, and (3) resistance to scaling and fouling of membranes. Sampling, analysis, and monitoring of the input and output streams were conducted during treatment to evaluate system percent rejection and recovery rate. Baseline testing was performed before and after leachate treatment to compare the system's pre-test and post-test flux (flow rate per unit membrane surface area), and thereby evaluate resistance to scaling and fouling. The test was designed to allow the system to operate for 21 days, 7 days per week, and up to 10 hours per day, long enough to allow several cycles of membrane cleaning.

**Preliminary Results:** Preliminary evaluation of the post-treatment data suggest the following conclusions:

- Percent rejections were greater than the test criteria of 99% for total dissolved solids, 92% for total organic carbon, and 99% for all target metals. In addition, the average percent rejection for volatile organic compounds was greater than the test criteria of 90%.
- The average water recovery rate for the DTM technology during the demonstration was approximately 75%. The test criteria was 75% treated water recovery rate.
- The DTM technology operated for 19 days at up to 8 hours per day. System operation conditions were not as long or as steady as planned due to weather and field operational difficulties. However, the system operated long enough to allow membrane cleaning, which helped to maintain technology performance.

Key findings from the demonstration, including complete analytical results, baseline test results, and an economic analysis will be published in an Innovative Technology Evaluation Report. This report will be used to evaluate the Rochem DTM technology as an alternative for cleaning up similar sites across the country. Results will also be presented in a SITE Technology Capsule and a videotape.

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